NRI research highlights

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Nutrients, Algae, and Water Quality in Estuarine Ecosystems

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Nearly 70 percent of North America's population resides within approximately 30 miles of a coastline. With human population growth and the burgeoning commercial development of coastal watersheds, nutrient-sensitive estuarine ecosystems in the United States are increasingly subject to nutrient loading and its unpleasant effects, including excessive algal growth.

Regulatory agencies overseeing these aesthetically pleasing and economically important habitats place a high value on protecting and preserving water quality through skillful nutrient management. To manage effectively, however, they need information about the influence of nutrients on estuaries.

With support from USDA's National Research Initiative (NRI) Competitive Grants Program, scientists at the University of North Carolina (UNC) at Chapel Hill are studying algal response to nitrogen inputs in the Neuse Estuary, a major tributary of North Carolina's Albemarle-Pamlico Sound Estuarine System. It is known that algal species may exhibit various growth responses to different types of nitrogen sources, such as nitrate and ammonia. Accordingly, the goals of the research are to (1) describe current nitrogen and algal conditions of the estuary and (2) investi-

UNC researcher inspects mesocosms containing Neuse Estuary water. Designed to simulate estuarine processes, mesocosms are used to study the effects of various nutrient inputs on algae growth.

Hans Paerl, UNC-CH Institute of Marine Sciences

In the past 15 years, nitrogen loading in the estuary has increased by at least 30 percent due to agricultural inputs and coastal urbanization.

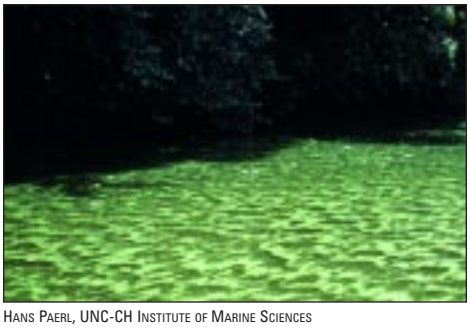
gate the effects of nitrate and ammonia inputs on estuaries by experimentally manipulating them in mesocosms (see illustration on previous page).

In the past 15 years, nitrogen loading in the Neuse Estuary has increased by at least 30 percent due to agricultural inputs — including proliferating livestock and poultry operations — and coastal urbanization. Nutrients reach the estuary from rivers as well as from atmospheric and groundwater sources.

High nitrogen loading accelerates algal production and supports massive blooms of free-floating, microscopic algal communities in estuaries — a process known as eutrophication (see illustration). The blooms, sometimes malodorous, may release toxins, foul waters and shorelines, and lead to oxygen depletion and widespread finfish and shellfish mortality.

Estuarine Impact

The results of the descriptive part of the project show that algal growth rates vary with the seasons and are inversely correlated with algal biomass (living matter).



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Algae growth is evident in this portion of the Neuse Estuary. The estuary is subject to nutrient loading from a variety of sources.

Algal biomass accumulates in the center of the estuary, whereas blooming begins in the part closest to the river mouth.

The observed groups included (1) cyanobacteria—blue-green algae-like bacteria; (2) diatoms—algae with silicified exoskeletons; (3) dinoflagellates—algae, some luminescent, with flagella; (4) cryptomonads—motile algae, excluding dinoflagellates, with flagella; and (5) chlorophytes—green algae. Each group contributes about 20 percent of the total algal biomass in the estuary.

In the mesocosm experiments, the researchers found that diatoms and dinoflagellates exhibited a regular seasonal bloom that was triggered in part by nitrogen input. Cyanobacterial, cryptophyte, and chlorophyte blooms occurred in response to high nitrogen loading in the summer. Nitrate stimulated more growth in diatoms than in the other categories of algae. In contrast, ammonium additions resulted in an increased abundance of cyanobacteria and cryptomonads.

The UNC research allows scientists to make predictions concerning the type of algae that will bloom in estuarine systems with various types and concentrations of nutrients as well as when and where blooms will occur. As the research progresses, scientists also will be able to predict the long-term impact of nutrients on algal growth, composition, and biomass in the estuarine ecosystem. ❖

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